

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

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PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY (PCT Rule 43bis.1)

Date of mailing

(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference

see form PCT/ISA/220

FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/DK2005/000223

International filing date (day/month/year)

31.03.2005

Priority date (day/month/year)

International Patent Classification (IPC) or both national classification and IPC

G06E3/00, G02B27/52, G02B27/46, G02B21/14

Applicant

GLÜCKSTAD, Jesper

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 56.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA:



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Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
 - ☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
 - a. type of material:
 - ☐ a sequence listing
 - ☐ table(s) related to the sequence listing
 - b. format of material:
 - ☐ in written format
 - ☐ in computer readable form
 - c. time of filing/furnishing:
 - ☐ contained in the international application as filed.
 - ☐ filed together with the international application in computer readable form.
 - ☐ furnished subsequently to this Authority for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-15
	No: Claims	
Inventive step (IS)	Yes: Claims	1-15
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-15
	No: Claims	

2. Citations and explanations

see separate sheet

IAP5 Rec'd PCT/PTO 28 SEP 2006

Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

1. The following documents are referred to in this communication:
D1: WO96/34307
D2: WO02/052332
- 2.1 Claim 1 does not satisfy the requirements of Article 6 PCT. Claim 1 concerns a phase contrast system designed to synthesize a "desired" output electromagnetic field. If "desired" is interpreted as referring to some particular fixed output (e.g. by using fixed phase masks as the first and second phase modifying elements), then claim 1 lacks clarity, since there is no indication as to what this particular "desired" output is. Furthermore, according to such an interpretation, claim 1 would also lack novelty over D1, since the focussing system (10) in D1 is a (second) phase modifying element (converting a plane phase-front into a spherical converging phase-front), and the resulting output is (presumably) "desired".
- 2.2 Consequently, it is considered that the only clear construction which can be put upon the term "desired" in claim 1 is that the system is *capable of synthesizing essentially any "desired" output electromagnetic field*. In other words, the system is capable of producing a variable output according to the desires of the operator. For purposes of examination, claim 1 is therefore interpreted in this sense.
- 2.3 However, claim 1 thus interpreted, contains embodiments which are not supported by the description as required by Article 6 PCT, i.e. embodiments in which the first and second phase modifying elements impart a fixed non-variable phase modulation on the wavefront (e.g. where both the first and second phase modifying elements are simply fixed-focus lenses). For such embodiments the skilled person would not be able to achieve the claimed technical effect of synthesizing various "desired" output electromagnetic fields.
- 2.4 It is clear from the application documents as filed that for an operator to be able to select a desired output, both the first and second phase modifying elements must be phase spatial light modulators. Thus the above objection under Article 6 PCT could have been overcome by:

- Incorporating the features of claim 10 into claim 1;
- Replacing in said claim 10 the phrase "wherein at least one of the first and second phase modifying element comprises" with "wherein both the first and second phase modifying element comprise"; and
- Deleting the word "input" (as it is inaccurate in relation to the second phase modifying element).

3. For the purposes of examination, claim 1 is interpreted as if the objections under Article 6 PCT mentioned above had been overcome in the manner set out in the previous paragraph.

4.1 Claim 1, construed in the above manner, appears to satisfy the requirements of Article 33(2) and 33(3) PCT for the following reasons: The document D2 is regarded as being the closest prior art and discloses (see fig 8): A phase contrast system for synthesizing an output electromagnetic field, comprising
a first spatial light modulator element (7);
first Fourier optics (8);
a spatial filter (10) for filtering the Fourier transformed electromagnetic radiation by
- in a region of spatial frequencies comprising DC in the Fourier plane phase shifting with a predetermined phase shift and multiplying the amplitude with a constant B, and
- in a region of remaining spatial frequencies in the Fourier or Fresnel plane, multiplying the amplitude with a constant A;
second Fourier optics (14) for forming an electromagnetic field by Fourier transforming the phase shifted Fourier transformed electromagnetic field, and
a second spatial light modulator element (24) for modulating the electromagnetic field into the desired output electromagnetic field.

4.2 Claim 1 differs from D1 in that both the first and second spatial light modulator elements are capable of modulating the phase. In D1 the modulators (7) and (24) are amplitude SLMs (at one point in D1, namely page 31, line 14, the element (24) is referred to as a "second phase modulator", but this appears to be an error; in the context of page 29, line 12 to page 31, line 27 and figure 8, it is clear that element (24) is an amplitude modulator).

4.3 The problem to be solved by the present invention is regarded as allowing the synthesis of

an electromagnetic field over a three dimensional volume (see page 2, lines 25-31). D1 is concerned only with modulating a two dimensional wavefront. Furthermore, since the underlying aim of D1 is provide phase modulation without using phase SLMs (see e.g. the abstract), it is not plausible that the skilled person would replace the amplitude SLMs of D1 with phase SLMs. In D1 the element (4) may be a phase SLM (page 9, second paragraph), but there is no second SLM. Thus the distinguishing features of claim 1 are neither disclosed nor suggested in the available prior art, and hence claim 1 is considered to involve an inventive step (Article 33(3) PCT).

5. Independent method claim 14, interpreted as stated in paragraph 3, *mutatis mutandis*, also appears to satisfy the requirements of Article 33(2) and 33(3) PCT for the reasons set out above, *mutatis mutandis*.
6. Claims 2-13 and 15 depend on claims 1 and 14 respectively, and therefore satisfy the requirements of Article 33(2) and 33(3) PCT.
7. Claims 13 and 14 lack clarity (Article 6 PCT) as the "preceding claims" do not relate to the systems specified. These claims should have been formulated as "An optical micro-manipulation or multi-beam optical tweezer system comprising the phase contrast system according to any of the preceding claims" and "A laser machining tool comprising the phase contrast system according to any of the preceding claims".